

**Combined Sewer Overflow/Stormwater
Outfall Investigation**

**Phase I Evaluation/
Recommendation Report**

Tierra Solutions, Inc.

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Acronyms and Abbreviations

CFC	continuous flow centrifuge
CH	clean hands
COC	constituent of concern
COPC	constituent of potential concern
COPEC	constituent of potential ecological concern
CSO	combined sewer overflow
CSO/SWO S&AP	Combined Sewer Overflow/Stormwater Overflow Sampling and Analytical Plan
DH	dirty hands
DOC	dissolved organic carbon
EDL	estimated detection limit
HSM	high-solids mass
LPRSA	Lower Passaic River Study Area
LSM	low-solids mass
MDL	method detection limit
mg/L	milligrams per liter
NOAA's NWS	National Oceanic and Atmospheric Administration's National Weather Service
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzop-dioxin
PCDF	polychlorinated dibenzofuran
Phase I Report	Phase I Evaluation/Recommendation Report
POC	particulate organic carbon

PQL	project quantitation limit
POTW	publicly owned treatment works
PVSC	Passaic Valley Sewerage Commission
QA	quality assurance
CSO/SWO InvestigationQAPP	Combined Sewer Overflow/Stormwater Outfall Investigation Quality Assurance Project Plan
QC	quality control
SIM	selective ion monitoring
SOP	standard operating procedure
SVOC	semivolatile organic compound
SWO	stormwater outfall
TAL	Target Analyte List
TDS	total dissolved solid
TEPH	total extractable petroleum hydrocarbons
Tierra	Tierra Solutions, Inc.
TOC	total organic carbon
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1. Introduction

This Phase I Evaluation/Recommendation Report (Phase I Report) has been developed by Tierra Solutions, Inc. (Tierra), on behalf of Occidental Chemical Corporation, the successor to Diamond Shamrock Chemicals Company (formerly known as Diamond Alkali Company.) This Phase I Report documents the evaluation of data collected as part of Phase I of the combined sewer overflow/stormwater outfall (CSO/SWO) investigation implemented under the U.S. Environmental Protection Agency (USEPA-) approved Combined Sewer Overflow/Stormwater Outfall Investigation Quality Assurance Project Plan (QAPP, Tierra 2013). The QAPP was developed to guide the collection of CSO, SWO, and publicly owned treatment works (POTW) samples from within the Lower Passaic River Study Area (LPRSA). The main objective of the CSO/SWO investigation is to characterize and quantify contaminants in both particulate- and dissolved-phases present in runoff discharging to the LPRSA via CSO and SWO conveyances, such that subsequent determinations of contaminant loadings can be made using models, developed by others, for the lower Passaic River.

The unique challenge of the CSO/SWO investigation is the quantification of organic contaminants found in the effluent of CSOs and SWOs, which are typically bound to particulates and, to a lesser degree, in the dissolved-phase. Quantitation limits associated with the particulate-phase of the effluent are particularly challenging to achieve, in that quantitation limits needed to reach the program data quality objectives require a sufficient mass of solids be collected for detection via standard USEPA-approved laboratory analyses. The challenges associated with collecting a sufficient mass of solids for analysis are one of the focuses of the Phase I investigation.

Various sampling methods have been used previously in the LPRSA to collect the necessary solids mass for analysis, with varying results. As such, a two-phased approach for the CSO/SWO investigation was developed in coordination with the USEPA. This two-phased approach incorporates, as Phase I, an initial side-by-side sampling program for evaluating three sampling approaches to inform the selection of the most appropriate sampling approach to quantify contaminants in the solid (particulate), dissolved, and whole water-phases: low-solids mass (LSM), high-solids mass (HSM), and whole water. Phase II of the program will consist of collecting CSO, SWO, and POTW samples at target locations using the sampling and analytical technique(s) selected after evaluation of Phase I results (the subject of this Phase I Report).

The LSM approach is a modification of the methods described in the USEPA Combined Sewer Overflow/Stormwater Overflow Sampling and Analytical Plan, Revision No. 2.0, August 2008 (CSO/SWO S&AP; USEPA 2008). The CSO/SWO S&AP was, in turn, based on methods that were implemented in the 1998 to 2004 Contaminant Assessment and Reduction Program (Great Lakes Environmental Center 2008) and the 2008 USEPA CSO/SWO solid phase sampling conducted by Malcolm Pirnie, Inc. (2008). The LSM approach requires modifications to standardized analytical methods for solids sample analysis because a relatively small mass of particulates is acquired during the sample collection procedure. The HSM approach was proposed in the LPRSA Remedial Investigation— Combined Sewer Overflow Investigation, Volume 1,

Work Plan/Field Sampling Plan Revision No. 1 (Tierra 2002). The HSM approach calls for the collection of a greater mass of particulate than the LSM method, and similar to the mass specified in standardized analytical methods. The whole water approach is similar to the LSM approach except that the particulate and dissolved-phases are not separated prior to analysis.

1.1 Organization of Report

The remainder of this Phase I Report is organized as follows:

- *Section 2 – Summary of Field Activities:* Summarizes the three sample collection methods and associated sample collection activities completed.
- *Section 3 – Summary of Evaluation Process:* Summarizes the process used to evaluate the implementability and effectiveness of the three sample collection methods.
- *Section 4 – Implementation Evaluation:* Summarizes the evaluation of the implementability of the three sample collection methods.
- *Section 5 – Analytical Data Evaluation:* Summarizes the evaluation of the analytical data obtained for the three sample collection methods.
- *Section 6 – Conclusions/Recommendations:* Summarizes the conclusions of the data evaluation process and provides the recommended path forward.
- *Section 7 – References:* Provides a summary of the references used in this Phase I Report.

2. Summary of Field Activities

Phase I sampling consisted of collecting and analyzing samples using three sample collection methods (LSM, HSM, and whole water) during two precipitation events at the selected CSO (Clay Street Newark, New Jersey). The field sample collection activities were implemented in accordance with the Field Standard Operating Procedures (SOPs) contained in the QAPP (Tierra 2013). It should be noted that the QAPP originally specified collection of samples from two different CSO locations: Clay Street CSO in Newark, New Jersey and Ivy Street CSO in Kearny, New Jersey. However, due to access limitations at the Ivy Street CSO imposed by the City of Kearny and to meet the Phase I implementation schedule, the USEPA and Tierra decided to collect an additional sample at the Clay Street CSO (for a total of two) in lieu of sampling at the Ivy Street CSO during Phase I. Modifications were made to the QAPP (Tierra 2013) to address this change.

2.1 Sample Collection System

A sample collection system was designed to collect all three sample types (LSM, HSM, and whole water) simultaneously from the same effluent stream and over the same period of time by controlling the flow rate of effluent entering different sample collection tanks and the continuous flow centrifuge (CFC). The sample collection system utilized an enclosed trailer as a secure platform for mounting/housing the sampling equipment and controls. Sampling equipment included a bulk sample collection tank, peristaltic pumps (one large-diameter peristaltic pump and three small-diameter peristaltic pumps), CFC, and associated tubing and fittings. A stand-alone tow-behind generator was staged near the sample collection trailer during sample collection. Figures 2-1, 2-2, and 2-3 present the schematic of the sample collection equipment setup. SOP No. 2 – Pre-Mobilization and SOP No. 3 – Mobilization, Bulk Sample Collection, and Transportation (Tierra 2013) provide additional details regarding the sample collection system.

During each sampling event, a weighted rod/tubing assembly (Figure 2-4) was deployed into the manhole of the diversion chamber at the Clay Street CSO for bulk sample collection. Large-diameter intake tubing (i.e., 1.125-inch outside diameter for large-diameter high-flow peristaltic pump) was secured to the weighted rod/tubing assembly and connected to a large-diameter high-flow peristaltic pump in the trailer to pump bulk sample for collection. Three sample ports were installed along the large-diameter intake tubing, two before, and one after the CFC. Small-diameter sample tubing and small-diameter peristaltic pumps were connected to the sample ports to pump bulk sample from the large-diameter intake tubing line into two bulk sample collection tanks (whole water/LSM and HSM dissolved bulk sample collection tanks). From an initial single sample flow stream, flow was continuously diverted to the Teflon®-lined (double-lined) whole water/LSM bulk sample collection tank (via the second sample port to generate the LSM and whole water samples) and the CFC (to generate solids in the centrifuge for HSM particulate analysis and CFC effluent for HSM dissolved analysis). A portion of the CFC effluent that passed through the CFC was diverted via the third sample port to the Teflon®-lined (double-lined) HSM dissolved bulk sample collection tank to generate HSM dissolved samples. The flow rate to each bulk sample collection tank was controlled so that the whole water/LSM bulk sample collection tank filled in approximately the same time as the HSM dissolved bulk sample collection

tank. The excess effluent that passed through the CFC was returned to the same manhole via large diameter tubing downstream of the CFC and HSM dissolved bulk sample collection tank.

The effluent entered the CFC from the bottom through a stationary feed nozzle and is directed towards the CFC bowl. A variable frequency drive mounted on the trailer was used to operate and control the speed of the CFC. Solids in the bulk effluent were forced to the bowl wall by centrifugal force. The interior of the CFC bowl was lined with a Teflon® liner to capture the separated solids. The clarified liquid was continuously discharged through the top of the centrifuge.

Following collection of effluent into the bulk sample collection tanks, aqueous (LSM bulk, HSM dissolved, and whole water) samples were collected using small-diameter peristaltic pumps and dedicated Teflon tubing from the bulk sample collection tanks. The LSM bulk samples were further processed at analytical laboratories, via filtration, to generate LSM particulate and LSM dissolved samples for analysis. HSM particulate samples were collected from the solids retained in the CFC bowl and liner for laboratory analysis. SOP No. 4 – Sample Processing and Collection (Tierra 2013) provides additional details on sample processing.

Upon receipt of LSM bulk samples by the laboratory, the equipment and procedures described in SOP No. L-24 – LSM Bulk Sample Filtration (Tierra 2013) were utilized to filter the LSM bulk sample, thereby generating LSM particulate and LSM dissolved samples for analysis. Post-filtration of the LSM bulk sample, particulate material captured on the filter media was put forward for analysis as the LSM particulate sample, while the filtrate was analyzed as the corresponding LSM dissolved sample. Two approaches were included in SOP No. L-24 – LSM Bulk Sample Filtration to filter the LSM bulk samples. The primary approach involved the use of pressurized filtration and a flat glass fiber filter(s). The secondary approach utilized a system by which bulk sample is pumped through a wound glass fiber filter cartridge and a flat glass fiber filter in series. The secondary approach was included for use as a contingency when/if excessive clogging was observed during implementation of the primary approach due to sample particulate mass characteristics, such as high total suspended solids (TSS) content or large individual particulate size.

During bulk sample collection at the manhole, TSS/total dissolved solids (TDS) grab samples were collected every 30 minutes via the first sample withdrawal port installed along the large diameter intake tubing prior to the CFC and whole water/LSM bulk sample collection tank. Additionally during sample collection, selected physiochemical water quality parameters (conductivity, turbidity, and temperature) were measured (logged continuously and manually recorded every 30 minutes using a water quality meter), water depth was measured at the sample collection manhole, and flow data were recorded. An in-line flow meter, located downstream of the CFC, was used to monitor and record flow rate approximately every 30 minutes.

Grab metals samples (including mercury and methyl mercury) were collected in accordance with SOP No. 5 – Metals Sampling via Method 1669 Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels (USEPA 1996) (Tierra 2013). This methodology has been developed based on USEPA Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels (USEPA

1996). Grab (total and dissolved) samples for trace metals analysis, including mercury and methyl mercury, and a TSS sample were collected directly from the manhole into laboratory-supplied containers using a separate peristaltic pump and laboratory-supplied Teflon® tubing. This sampling method was employed so that metals samples could be collected using “clean hands” (CH) and “dirty hands” (DH) sampling methods that minimize potential sample contamination from trace metals during sample collection. Sampling activities were conducted with care to minimize exposure of the sample to atmospheric, human, and other sources of potential metals contamination. Dissolved metals samples were collected first by field-filtering (via an in-line filter) the effluent followed by collection of samples for total metals analysis.

2.2 Mobilization for Sample Collection

During Phase I, Tierra conducted weather monitoring on a daily basis using multiple sources to evaluate timing of mobilization for sample collection. For a precipitation event to trigger mobilization for sample collection, the event must have anticipated to produce at least 0.2 inch of rain with an average intensity of at least 0.03 inch per hour with no more than 4 consecutive dry hours during the event. Following a decision to mobilize for sample collection, staff mobilized the sample collection system to the sampling location. Tierra coordinated/communicated with Passaic Valley Sewerage Commission (PVSC) to determine timing of the regulator gate valve closing at the Clay Street CSO and appropriate time for initiating sample collection. Sample collection was only initiated after PVSC confirmed that the regulator gate valve was closed at the Clay Street CSO and that an overflow was occurring. In addition, a sidewalk occupancy permit was obtained in advance from the City of Newark to stage the sample collection system along the sidewalk at the Clay Street CSO; the Newark Police Department were also contacted to provide traffic control. Following bulk sample collection, the sample collection system was transported back to the processing facility at 80 Lister Avenue in Newark, New Jersey. Samples were shipped to analytical laboratories the day after bulk sample collection in accordance with the procedures outlined in the QAPP (Tierra 2013).

2.3 Sample Collection– Clay Street Combined Sewer Overflow

Phase I sampling was completed at the Clay Street CSO between June 2013 and April 2014. It was critical that sufficient sample mass and/or volume be obtained to accomplish the primary objective of this phase: the evaluation and selection of the most appropriate sampling method for each analytical group. For this reason, an analytical hierarchy was established for sample collection. For a given sampling event, if sufficient volume was obtained to complete sampling via the three methods for the analytical groups and matrices, then samples were generated in the sequence described in the analytical hierarchy detailed in the QAPP (Tierra 2013) (with the exception of samples for volatile organic compound (VOC) analysis, which were collected first). In addition to the sample mass/volume required for primary sample analysis (including quality assurance/quality control [QA/QC] samples), contingency sample mass/volume was collected and shipped to the laboratories to mitigate any potential issues related to sample breakage/loss during sample shipment and analysis. Multiple attempts were needed during each sampling event at the Clay Street CSO to collect all samples (primary and contingency) for the target analytical groups using the three sampling approaches.

Table 2-1 summarizes the number and type of samples collected and analyzed during each sampling event/attempt as part of the Phase I sampling program

Table 2-1
Summary of Samples Collected and Analyzed

Event and Attempt	Sample Identification	Date	Collection Method and Analytical Parameters		
			HSM	LSM	Whole Water
Event #1, Attempt #1 ^b	PR1CSOCLY**-01A PR1**-DUP-01A	June 10, 2013	PCDDs/PCDFs, PCB congeners	PCDDs/PCDFs, PCB congeners	PCDDs/PCDFs, PCB congeners, metals, mercury, and methyl mercury
Event #1, Attempt #2	PR1CSOCLY**-01B PR1**-DUP-01B	July 1, 2013	All ^a , excluding PCDDs/PCDFs, PCB congeners, POC, grain size, metals, mercury and methyl mercury	All ^a , excluding PCDDs/PCDFs, PCB congeners, TOC, grain size, VOCs, cyanide, TEPH, metals, mercury and methyl mercury	All ^a , excluding PCDDs/PCDFs, PCB congeners, DOC, POC, metals, mercury and methyl mercury
Event #1, Attempt #3 ^c	PR1CSOCLY**-01C PR1**-DUP-01C	April 30, 2014	PCDDs/PCDFs, PCB congeners, chlorinated herbicides	PCDDs/PCDFs, PCB congeners, chlorinated herbicides	PCDDs/PCDFs, PCB congeners, chlorinated herbicides
Event #2, Attempt #1	PR1CSOCLY**-02A PR1**-DUP-02A	October 7, 2013	VOCs	-	VOCs
Event #2, Attempt #2 ^b	PR1CSOCLY**-02B PR1**-DUP-02B	December 7, 2013	All ^a , excluding VOCs, grain size, POC, metals, mercury and methyl mercury	All ^a , excluding VOCs, TOC, grain size, cyanide, TEPH, metals, mercury and methyl mercury	All ^a , excluding VOCs, DOC, POC

Notes:

- All includes the following analyses: polychlorinated dibenz-p-dioxins/polychlorinated dibenzofurans (PCDDs/PCDFs), polychlorinated biphenyl (PCB) congeners, Aroclor PCBs, organochlorine pesticides, semivolatile organic compounds (SVOCs), SVOC selective ion monitoring (SIM), chlorinated herbicides, metals, mercury, methyl mercury, cyanide, VOCs, total extractable petroleum hydrocarbons (TEPH), TSS, TDS, total organic carbon (TOC), particulate organic carbon (POC), dissolved organic carbon (DOC), and grain size.
- Grab total and dissolved metals (including mercury and methyl mercury) samples were collected on June 10, 2013 (Event #1, Attempt #1) and December 7, 2013 (Event #2, Attempt #2).
- During Event #1, Attempt #1, two types of solid material ("fine" and "non-fine paper like material") were recovered in the centrifuge bowl. To be consistent with sediment homogenization implemented in subsequent events/attempts (i.e., "fines" and "non-fines" were combined and homogenized), PCDDs/PCDFs and PCB congener samples were collected during Event #1, Attempt #3 (which occurred after both Event #2 attempts) to replace the Event #1, Attempt #1 PCDDs/PCDFs and PCB congener results. In addition chlorinated herbicides were collected during Event #1, Attempt #3 to obtain an additional set of herbicide data due to a laboratory error identified during the herbicide analysis of the HSM particulate sample. Laboratory results indicated that a laboratory control sample associated with the herbicide data had failed during Event #2, Attempt #2.

* Grab TSS/TDS samples were collected every 30 minutes during each sampling event/attempt in addition to the TSS/TDS samples collected as part of HSM, LSM, and whole water sampling methods.

** = Two-character code to indicate sample matrix (e.g., "HP" for HSM particulate)

- = sample not collected/analyzed.

The PCDDs/PCDFs, PCB congeners, and organochlorine pesticides were analyzed by Ista Analytical in El Dorado Hills, California. Brooks Rand laboratory in Seattle, Washington analyzed the total and dissolved metals (including mercury and methyl mercury) samples. The remainder of the analyses was performed by TestAmerica in Burlington, Vermont.

2.4 Decontamination/Cleaning

Applicable decontamination procedures were followed throughout the Phase I sample collection program in accordance with SOP No. 6: Decontamination included in the QAPP (Tierra 2013). Between sampling events, a full decontamination of the sample collection system was performed in accordance with Section 2.2.2 of SOP No. 6: Decontamination, included in the QAPP (Tierra 2013). Field sampling equipment designated for analyses other than trace metals (i.e., CFC bowl, CFC bowl Teflon® liner, CFC components, stainless steel fittings, and stainless steel tools used for HSM particulate sample collection) was decontaminated prior to the first sampling attempt for each event. Dedicated sampling equipment (i.e., CFC bowl Teflon® liner, Teflon® tank liners, and small- and large-diameter Teflon® sample tubing) were replaced with new dedicated sampling equipment between events.

Between sampling attempts (e.g., between Attempts #1 and #2 of Event #1) non-dedicated sampling equipment used for HSM particulate sample collection (e.g., CFC bowl, CFC bowl Teflon® liner, CFC components, stainless steel bowls and spoons) was fully decontaminated in accordance with Section 2.2.3 of SOP No. 6, included in the QAPP (Tierra 2013). Note that permanently attached stainless steel fittings associated with the sampling system prior to entry into the CFC bowl were not fully decontaminated; however, a "gross cleaning" procedure was followed as per SOP No. 6 by circulating deionized water through the system. Dedicated sampling equipment (Teflon® tank liners and Teflon® tubing) were not replaced between sampling attempts (unless damaged) as per SOP No. 6.

3. Summary of Evaluation Process

Phase I data was evaluated, on an analytical group basis, for each sampling approach using the following criteria as defined in the QAPP (Tierra 2013):

- ☐ Implementability of field sampling and sample processing activities
- ☐ Ability to generate sample mass/volume to accommodate the full target analytical groups
- ☐ Ability of laboratories to generate usable data
- ☐ Ability to generate greater frequency of detection for analytes that are constituents of potential concern (COPCs) and/or constituents of potential ecological concern (COPECs) listed in the Lower Eight Miles of the Lower Passaic River Feasibility Study Report (The Louis Berger Group 2014)
- ☐ Ability to generate greater frequency of detection for analytes within a given analytical group

Analytical groups included in the evaluation were limited to those where samples were collected using two or more of the sampling methods (HSM, LSM, and/or whole water) therefore, the Phase I evaluation process included comparison of the analytical groups as defined in Table 3-1 below.

Table 3-1
Analytical Groups Included in Phase I Evaluation Process

Analytical Group	Sampling Methods Implemented			Analytical Group Included in Phase I Evaluation Process?
	HSM	LSM	Whole Water	
PCDDs/PCDFs	x	x	x	Yes
PCB Congeners	x	x	x	Yes
Aroclor PCBs	x	x	x	Yes
Organochlorine Pesticides	x	x	x	Yes
SVOCs	x	x	x	Yes
SVOC SIM	x	x	x	Yes
Chlorinated Herbicides	x	x	x	Yes
Cyanide	x	-	x	Yes
VOCs	x	-	x	Yes
TEPH	x	-	x	Yes
TSS	x	x	x	No
TDS	x	x	x	No
TOC	x	-	x	No
POC	-	x	-	No
DOC	x	x	-	No
Grain Size	-	-	x	No
Metals	-	-	x	No
Mercury	-	-	x	No
Methyl mercury	-	-	x	No

Notes:

x = analytical sampling method was performed

- = analytical sampling method was not performed

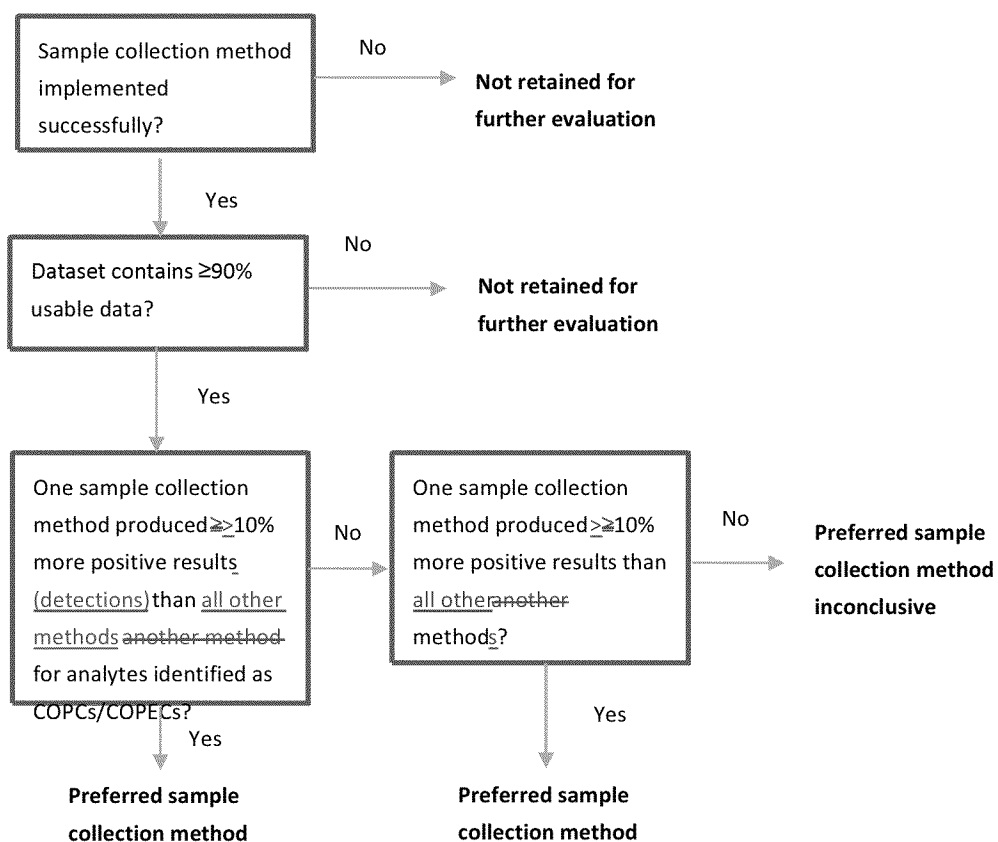
The Phase I evaluation process was carried out according to the approach specified in Worksheet #17 of the QAPP (Tierra 2013). The evaluation process consisted of the following four sequential steps:

- *Step 1 – Implementability:* Implementability was defined as successful collection and processing of samples for laboratory analysis meeting minimum requirements as listed in Worksheets #19-1 through #19-4 of the QAPP.
- *Step 2 – Data Quality:* Data quality was determined based upon the outcome of the data validation task (outlined in Worksheet #36 and included as Appendix C of the QAPP). Data flagged “R” were rejected based upon the project-defined validation procedures and were not considered to be usable. Datasets for a particular analytical group containing a minimum of 90% usable data were further evaluated.
- *Step 3 – Frequency of Detections of COPCs/COPECs:* If, for a given analytical group, one sample collection method produced greater than 10% more positive results (detections) than all other methods, then that sample collection method was identified as the preferred sample collection method for that particular analytical group.
- *Step 4 – Frequency of Detections of All Analytes:* If, for a given analytical group, one sample collection method produced greater than 10% more positive results (detections) than all other methods, then that sample collection method was identified as the preferred sample collection method for that particular analytical group. Note Step 4 of the evaluation process was completed only in cases where a preferred sample collection method could not be determined based on Step 3.

If for a given analytical group, no sample collection method produced greater than 10% more positive results (detections) than all other methods, then the preferred sample collection method for that analytical group was identified as inconclusive.

The evaluation process is represented below.

Figure 3-1: Phase I Evaluation Process Flow Chart

**Notes:**

1. Steps 1 and 2 were carried out individually for each analytical group, for each sampling method, and for each sampling event and attempt.

2. If for a given analytical group, no sample collection method produced greater than 10% more positive results (detections) than all other methods, then the preferred sample collection method for that analytical group was identified as inconclusive.

Section 4 describes the results of the evaluation process with respect to implementability (Step 1). The results of the evaluation process with respect to analytical data evaluation (Steps 2 to 4) are described in Section 5. Results are documented on the comparison charts outlined in Worksheet #11 of the QAPP (Tierra 2013) (included as Appendices A to J) and referenced in the applicable sections(s) of this Phase I Report.

4. Implementation Evaluation

As discussed in Section 3, the first step in the evaluation process is an assessment of implementability. Implementability is defined as the degree to which each sample collection method was successful in collecting the required samples for laboratory analysis and meeting the minimum analytical SOP requirements as defined in the QAPP (Worksheets #191 through 194; Tierra 2013). For any given sampling attempt, if a sample collection method was not successful in collecting samples for laboratory analyses, it would not be considered for further evaluation and was not included in the comparison of sample collection methods for that analytical group(s).

The following sections discuss implementation challenges common to all sample collection methods for consideration during the ultimate selection of sample collection method(s). A comparison of the sampling approaches with respect to implementation challenges encountered and ability to successfully generate target mass/volume for laboratory analysis is presented below.

4.1 Implementation Requirements and Challenges

Mobilization requirements were common for all sample types. Specific mobilization requirements and challenges addressed during the sample collection activities included the following:

- ☐ Site access and sidewalk closure and occupancy permit
- ☐ Coordination with Newark Police
- ☐ Weather monitoring
- ☐ Coordination with PVSC
- ☐ Storm duration.

A sidewalk closure and occupancy permit was obtained from the City of Newark to access and stage the sample collection system at the Clay Street CSO. Such permit would be required for any sampling approach utilized in Phase II. The permit application was initially prepared and approved prior to the first sample collection event and renewed every 30 days during the Phase I sampling program. Therefore, the permit was in place at all times during the potential sample collection period. Typically, the City of Newark does not issue permit renewals and requires submitting a new permit application. However, because the sample collection task is rainfall dependent, the City of Newark agreed to issue permit renewals every 30 days. Sampling location within different townships may be subject to different requirements.

Tierra coordinated with the City of Newark police during sample collection to provide traffic/site safety control in accordance with New Jersey Department of Transportation regulations. The Clay Street CSO sampling location is located at the intersection of Clay Street and McCarter Highway in Newark, New Jersey. Due to

heavy traffic and the need to occupy the sidewalk, police support was required to provide traffic control. Additionally, site safety was needed to facilitate collection of bulk samples during nights and weekends.

Weather monitoring was performed during Phase I sample collection to determine an appropriate time to initiate mobilization for sample collection. The QAPP (Tierra 2013) states the following criterion for mobilization: "For a precipitation event to trigger mobilization for sample collection, the event must be anticipated to produce at least 0.2 inch of rain with an average intensity of at least 0.05 inch per hour with no more than 4 consecutive dry hours during the event. Based on the target storm duration of four to six hours for sample collection, the length of the rainfall period expected to meet the mobilization criteria was also considered. A four to six hour sample collection period was targeted as this was the length of time anticipated to be needed to collect enough solids within the CFC to obtain samples based on the limited existing TSS data for CSO effluent. Tierra screened various weather forecast providers to select a precipitation forecast provider to predict storm events to prepare and quickly respond to potential storm events for sample collection. Given the capabilities of the weather services evaluated, The Weather Channel and Weather Underground were used for general, long term (7- to 10-day) weather monitoring, while the National Oceanic and Atmospheric Administration's National Weather Service (NOAA's NWS) was used for more precise monitoring (6- and 3-day forecasts) to evaluate the potential precipitation on an hourly basis. The NOAA's NWS station located at the Newark Liberty International Airport, New Jersey was identified as the location closest to the CSO location for the Phase I CSO/SWO sampling program. During periods of anticipated sample collection, monitoring of the forecast weather from the three providers was reviewed on a daily basis. Tierra monitored the forecast daily and whether there were events within 10, 7, 6, or 3 days with the potential to trigger mobilization for sample collection. Tierra then notified other members of the project team if an event was identified to trigger mobilization.

Following the initiation of Phase I sample collection, based on a comparison of actual (hourly precipitation data in inches available through NOAA's NWS) and predicted precipitation data and overflows recorded at the Clay Street CSO for various storm events, the mobilization criterion was modified from an average rainfall intensity of at least 0.05 inch per hour to an average intensity of at least 0.03 inch per hour. It was identified that several overflow events were missed due to the 0.05 inch per hour average rainfall intensity mobilization criterion and that an average intensity of 0.03 inch per hour resulted in sufficient overflow conditions at the Clay Street CSO. Therefore, the mobilization criterion was changed to 0.03 inch per hour for rainfall intensity. The mobilization criterion for total rainfall remained the same (0.2 inch of rain).

Although the modification to the mobilization criteria resulted in mitigating missed overflows, sample collection could not be completed during six mobilization events due to other factors including the following:

- ☐ No rainfall or less than anticipated rainfall, contrary to forecast conditions
- ☐ No overflow occurrence during rain events that met the mobilization criteria

- Overflow lasted for less than the target duration of 4 to 6 hours resulting in no sample collection
- Water level in the diversion chamber manhole was low (approximately 1 foot from the bottom), limiting the ability of the intake tubing to pump effluent and remain 1 foot off the bottom as required by the QAPP (Tierra 2013)
- An operational issue with the CFC.

During anticipated storm events, Tierra coordinated with PVSC regarding the timing of regulator gate valve openings at the sampling location. During a storm event, as soon as the regulator gate valve was opened at the Clay Street CSO, PVSC contacted Tierra to notify them of the gate opening and overflow conditions at the Clay Street CSO. Sample collection was initiated following PVSC confirmation regarding gate opening. Following the storm event, PVSC contacted Tierra with notification that the regulator gate valve was closed at the Clay Street CSO indicating the end of overflow conditions. PVSC had informed Tierra that overflows can occur without the regulator gate being opened. During one mobilization event on October 7, 2013, the sampling crew observed overflow at the Clay Street CSO location and bulk sample collection was initiated although Tierra did not receive notification that the regulator gate valve had been opened (and, therefore, presumably was not).

4.2 Evaluation of Sampling Methods

The following subsections discuss the challenges associated with each of the sampling methods (HSM, LSM, whole water, and grab metals) and the measures taken to address such challenges. The systematic evaluation of these methods is governed by the implementability of the sampling methods and the ability to generate target sample mass/volume to accommodate the full suite of target analytes.

4.2.1 High-Solids Mass

4.2.1.1 High-Solids Mass Particulate

As described in Section 2, HSM particulate samples were generated from the solids retained in the CFC bowl, and the samples were processed and shipped to analytical laboratories the day after bulk sample collection.

Implementation Challenges and Logistics

Minor challenges were encountered during sample collection, and modifications were implemented to address these challenges.

The CFC setup is more labor intensive as compared to the other sample collection methods (whole water and LSM). The CFC sampling equipment has moving parts and thus the potential for breakdown. To address the labor requirements and the complexity of operating the system, prior to the start of Phase I sample collection, an adequate number of personnel were trained to setup and operate the centrifuge and were required to be familiar with the SOPs and manufacturers' specifications of the multiple systems in the sample collection trailer. As part of the CSO/SWO investigation, a field demonstration and testing of the sample collection system was conducted on August 24, 2012 at the Ivy Street CSO outfall located in Kearny, New Jersey.

During all sampling attempts at the Clay Street CSO, two material types ("fines" and "non-fine paper-like material") were encountered in the CFC bowl during HSM particulate sample collection. The challenge was to create a homogeneous particulate sample for laboratory analysis. A modification to the SOP was implemented and a stainless steel blender was used to process and blend the fines and non-fines material to create a homogenous particulate sample for laboratory analysis. SOP No. 4 – Sample Processing and Collection (Tierra 2013) provides additional details on the blending process. The HSM particulate placed into sample containers by the field team during the first attempt of the first event consisted of only the fines portion of the HSM particulate material. Because this sample was not homogenized with the non-fines portion of the particulate, as was the case during all subsequent sampling attempts and events, data from this first sampling attempt was not considered useable for purposes of the Phase I evaluation and were not considered further and are not included in this Phase I Report. PCDDs/PCDFs and PCB congener sample results for Event #1, Attempt #1 are included in Appendix A and B, respectively.

During pre-Phase I blank collection and decontamination activities, it was observed that small particulates remained in the CFC following prescribed decontamination procedures and caused potential issues with CFC operation. It was decided to add a decontamination step to power wash the CFC bowl to remove the residual particulates. The power washing step adds more time to the decontamination process, but avoids potential operational issues with the CFC.

A significantly fewer number of sample containers were required to ship the HSM particulate samples (primary and contingency) compared to the LSM and whole water sample collection methods and, therefore, resulted in lower actual bottle breakage during shipping and required less time for sample packaging and shipment.

Ability to Generate Target Sample Mass/Volume

The HSM sample collection method generated sufficient solids mass required for the targeted sample analyses. A minimum of two sampling attempts was needed to generate the targeted solids mass (2,400 grams; including QA/QC samples and primary and contingency samples) during each sampling event. During a single sampling attempt (6-hour sample collection), sufficient solids mass (approximately 1,550

grams) was generated to collect primary samples (including QA/QC) to accommodate the full targeted analytical groups (1,130 grams). An additional sampling attempt was needed to accommodate contingency sample mass for laboratory analysis. Note that this observation is based on one sampling location (Clay Street CSO) and solids mass retained in the CFC will vary at different CSO locations; it is dependent on the influent TSS.

Contingency Mass/Volume

No contingency samples were used in the HSM particulate sample collection method (see Appendix C).

4.2.1.2 High-Solids Mass Dissolved

As described in Section 2, the HSM dissolved samples were generated by subsampling from the HSM dissolved bulk sample collection tank using a small diameter peristaltic pump and dedicated Teflon tubing, and the samples were processed and shipped to analytical laboratories the day after bulk sample collection.

Implementation Challenges and Logistics

The challenges identified above for HSM particulate sampling with regards to operation and decontamination of the CFC apply to the HSM dissolved sampling.

A secondary tank was needed around the HSM bulk sample collection tank to facilitate the placement of ice which was used to immediately begin to chill and to then maintain the cool temperature of the HSM dissolved bulk sample.

Due to the high sample volume required for each analytical group larger (than typically used for standard aqueous analytical methods) sample containers were required to ship HSM dissolved samples compared to the HSM particulate sampling method and, therefore, resulted in bottle breakage during shipping and required more time for sample processing and shipment. However, approximately the same number of sample containers were needed to collect the HSM dissolved samples as the LSM bulk and whole water samples. Additional sample packaging steps (e.g., bubble wrap, pre-cut foam inserts) were undertaken to mitigate bottle breakage during sample shipment.

Ability to Generate Target Sample Mass/Volume

One successful six-hour sampling attempt/event was needed to generate the target sample volume (approximately 230 liters; including QA/QC samples and primary and contingency samples) to accommodate the full targeted analytical groups. However, as noted in Section 2, only a portion of the effluent stream from the CFC was diverted to the HSM bulk sample collection tank. The rate at which the effluent

was pumped from the CFC effluent stream into the HSM bulk sample collection tank could potentially be modified to collect the required volume for HSM dissolved samples within a shorter time period

Contingency Mass/Volume

HSM dissolved contingency volumes utilized are described below and are outlined in Appendix C.

- *Event #1, Attempt #1 HSM dissolved:* Two contingency bottles were utilized for PCB congener analyses due to breakage of primary sample containers observed upon laboratory receipt.

4.2.2 Low-Solids Mass

4.2.2.1 Low-Solids Mass Bulk Sample Collection

Similar to HSM dissolved samples, LSM bulk samples were generated for laboratory analyses by subsampling from the whole water/LSM bulk sample collection tank using a small diameter peristaltic pump and dedicated Teflon® tubing, and the samples were processed and shipped to analytical laboratories the day after bulk sample collection. The laboratory completed filtration of the LSM bulk sample to generate LSM particulate and LSM dissolved samples.

Implementation Challenges and Logistics

The challenges identified above for HSM dissolved sampling (i.e., need for a secondary tank and large sample volumes/containers) apply to the LSM bulk sampling.

LSM bulk sample collection is similar to HSM dissolved sample collection, except the LSM bulk sample is collected prior to the CFC. As such, LSM bulk sample collection setup is generally less labor intensive compared to the HSM sample collection method.

As discussed in Section 2, the LSM/whole water bulk sample collection tank was double-lined with a Teflon® liner. During sample processing activities on December 9, 2013, a tear/rip was observed at the bottom of the inside Teflon® liner of the double-lined LSM bulk/whole water bulk sample collection tank after mixing and subsampling activities began. Water was collected from within the inner liner of the double-lined tank, and excess water remained in the tank at the end of sampling. It was not necessary to collect water from between the two Teflon® liners. The potential for liner tear/rip was identified during design of the sample collection system, and the bulk sample collection tanks were double-lined with Teflon® liners to avoid potential for bulk effluent to leak from the Teflon® liner and contact the tank. As such, no negative impacts to the sample were identified due to the identified tear/rip.

Ability to Generate Target Sample Mass/Volume

One successful 6-hour sampling attempt/event was needed to generate the target sample volume (approximately 450 liters, including QA/QC samples and primary and contingency samples) to accommodate the full target analytical groups. However, as noted in Section 2, only a portion of the effluent stream from the manhole was diverted to the LSM bulk sample collection tank. The rate at which the effluent was pumped from the effluent stream into the LSM bulk sample collection tank could potentially be modified to collect the required volume for LSM bulk samples within a shorter time period.

4.2.2.2 Low-Solids Mass Bulk Laboratory Filtration

As described in Section 2, LSM bulk samples were generated by filtration at the laboratory.

Implementation Challenges and Logistics

The laboratory successfully filtered all of the LSM bulk samples using the primary approach. Although filtration of LSM bulk samples was relatively time consuming (as described below), the use of this secondary approach was not necessary.

The LSM bulk sample separation procedure is labor intensive due to the preparatory decontamination and setup requirements of the multicomponent equipment. The LSM bulk sample separation equipment (for both the primary and secondary approach), comprise multiple components including various tubing and filter media housing. These component parts require rigorous decontamination and associated blank collection, between uses in separating LSM bulk material obtained from different sampling events. Additionally, the filter media used to separate the LSM bulk samples is pre-cleaned in lots prior to use to verify that filters are not contributing any contamination to the LSM samples during bulk sample filtration. A representative filter from the lot is selected and submitted for laboratory analysis. Results of the analyses are used to certify that the filter media are contaminant-free or to establish background contaminant concentrations in the filter media as applicable. Pre-cleaned filter media must be recertified to re-establish contaminant background concentration if not used to separate samples over a period greater than 6 months from the initial evaluation.

The LSM bulk sample separation procedure is time consuming as it requires the filtration of large volumes of LSM bulk sample to meet the analytical sensitivity requirements established in the QAPP (Tierra 2013). Table 4-1 below identifies the volume requirements for each analytical group.

Table 4-1
LSM Bulk Liquid Volume Requirements by Analytical Group

Analytical Group	Minimum Sample Volume Required (liters)	Actual Sample Volume Collected per Event (liters)
PCDD/PCDFs	40	40
PCB Congeners	20	20
Organochlorine Pesticides	10	10
SVOCs	10	10
SVOC SIM	10	10
Aroclor PCBs	4	4
Chlorinated Herbicides	4	4
POC/DOC	16	16
TSS	3	3
TDS	1.5	1.5

Minimum sample volume requirements listed above are per event and include the primary sample, field duplicate, and associated QA/QC samples. During Phase I, approximately 120 liters of LSM bulk sample were collected and processed during each event requiring approximately 48 labor hours. This volume/time does not take into consideration contingency volume that might be needed.

Ability to Generate Target Sample Mass/Volume

The LSM bulk sample filtration process did generate acceptable target sample volume for LSM dissolved samples. However, the LSM bulk sample filtration process was insufficient in generating the target sample mass for LSM particulate samples. Table 4-2 provides the targeted and corresponding actual LSM bulk sample volume filtered to produce the LSM dissolved samples. Table 4-3 provides the targeted sample mass for LSM particulate samples for each analytical group per event, as well as the corresponding actual mass of LSM particulate samples collected and analyzed by the laboratory during Phase I.

Table 4-2
Targeted LSM Dissolved Volume and Corresponding Actual LSM Bulk Volume Filtered by Analytical Group

Analytical Group	Targeted LSM Dissolved Sample Volume (liters) ^a	Event #1, Attempt #1 LSM Bulk Volume Filtered (liters) ^{b,c}	Event #1, Attempt #2 LSM Bulk Volume Filtered (liters) ^b	Event #1, Attempt #3 LSM Bulk Volume Filtered (liters) ^b	Event #2, Attempt #2 LSM Bulk Volume Filtered (liters) ^{b,d}
PCDD/PCDFs	10	10.035	-	9.663	9.476
PCB Congeners	5	4.957	-	5.009	4.819
Organochlorine Pesticides	2.5	-	2.558	-	2.430
SVOCs	2.5	-	2.363	-	2.418
SVOC SIM	2.5	-	2.530	-	2.400
Aroclor PCBs	1	-	0.979	-	1.013
Chlorinated Herbicides	1	-	0.984	1.053	1.042
POC/DOC	4	-	4.057	-	4.147

Notes:

- Target volume is for sample only and does not include QC volume requirements.
 - LSM bulk filtered volume presented are that of the original field sample only (without additional QC volume requirements) allowing direct comparison with the target volume value provided for each analytical.
 - As a result of only the "fine" material being analyzed for Event #1, Attempt #1, PCDDs/PCDFs and PCB congener samples from Event #1, Attempt #1 were "replaced" by Event #1, Attempt #3. Therefore, Event #1, Attempt #1 results were not included as part of the data evaluation process.
 - No LSM samples were collected during Event #2, Attempt #1.
- = analytical group was not analyzed

Table 4-3
Targeted LSM Particulate Mass and Corresponding Actual LSM Particulate Mass by Analytical Group

Analytical Group	Targeted LSM Particulate Mass (grams) ^a	Event #1, Attempt 1 LSM Particulate Mass (grams) ^b	Event #1, Attempt #2 LSM Particulate Mass (grams) ^b	Event #2, Attempt #2 LSM Particulate Mass (grams) ^b	Event #1, Attempt #3 LSM Particulate Mass (grams) ^b
PCDD/PCDFs	1.5	0.370 ^c	-	0.079	0.077
PCB Congeners	0.75	0.183 ^c	-	0.040	0.040
Organochlorine Pesticides	0.375	-	0.166	0.020	-
SVOCs	0.375	-	0.163	0.020	-
SVOC SIM	0.375	-	0.160	0.020	-
Aroclor PCBs	0.15	-	0.068	0.008	-
Chlorinated Herbicides	0.15	-	0.064	0.009	0.008
POC	0.60	-	0.263	0.010	-

Notes:

- Target sample mass was based on a historical TSS average of 150 milligrams per liter (mg/L). These values reflect the minimum sample mass set as a requirement for a single sample analysis and do not include additional QC mass requirements.
- LSM particulate mass values observed during the field investigation are that of the original field sample only (without additional QC mass requirements) allowing direct comparison with the target mass value provided. LSM particulate samples were not collected during Event # 2, Attempt # 1.

- c. As a result of only the "fine" material being analyzed for Event #1, Attempt #1, PCDDs/PCDFs and PCB congener samples from Event #1, Attempt #1 were "replaced" by Event #1, Attempt #3. Therefore, Event #1, Attempt #1 results were not included as part of the data evaluation process
- = analytical group was not analyzed

The low mass obtained for the LSM particulate samples is related to significantly lower (as low as 8 mg/L) than anticipated (150 mg/L) TSS concentrations observed during the sampling events/attempts at the Clay Street CSO. Reduced sample mass has a direct relationship with reduced analytical sensitivity; however, the LSM sample results were retained for further evaluation as part of the Phase I evaluation process. The smaller than anticipated sample size obtained for LSM particulates may be linked to the larger number of non-detected results observed for many of the constituents of concern (COCs) as a direct cause and effect. This is especially true for the hydrophobic constituents, which are associated in large part with the particulate, rather than the dissolved-phase of the CSO overflow. This is a limitation of the LSM sample collection method. Even if the anticipated LSM particulate sample size had been collected, the mass of particulates obtained would have been approximately 10 to 100 times less than the HSM particulate sample mass. Therefore, it is unclear if the targeted LSM particulate sample size would have produced a greater number of positive results for COCs when compared to the HSM particulate samples.

To account for potential low TSS and corresponding low LSM particulate sample mass during future sampling events, the possible addition of real-time TSS monitoring using a turbidimeter or similar equipment will be evaluated to make field adjustments for the volume of water that needs to be collected for LSM bulk samples.

Contingency Mass/Volume

No contingency sample masses or volumes were used in the LSM sample collection method (see Appendix C).

4.2.3 Whole Water

As described in Section 2, whole water samples were generated for laboratory analyses by subsampling from the LSM whole water bulk sample collection tank using a small-diameter peristaltic pump and dedicated Teflon® tubing, and the samples were processed and shipped to analytical laboratories the day after bulk sample collection.

The whole water sampling method is identical to the LSM bulk sampling method, with the only difference being there is no laboratory filtration to generate particulate and dissolved samples.

Contingency Mass/Volume

Whole water contingency volumes utilized are described below and are outlined in Appendix C to this Phase I Report.

- *Event #1, Attempt #1 Whole Water:* Thirty-three contingency bottles were utilized for PCDD/PCDFs and PCB congener analyses due to breakage in the primary sample upon laboratory receipt and several coolers being out of temperature range. Further, in the case of PCDD/PCDFs analysis, the sample, matrix spike, and matrix spike duplicate were re-extracted using contingency volume after solid-phase extraction disc clogging problems occurred during the original extraction.
- *Event #2, Attempt #2 Whole Water:* Four contingency bottles were utilized for organochlorine pesticide analysis of the primary sample and duplicate sample due to the delayed sample arrival of the primary samples to the laboratory. The laboratory was instructed to only use contingency volumes for the entire analysis (i.e., primary sample, duplicate, matrix spike, and matrix spike duplicate).

Sixteen contingency bottles were utilized for PCDD/PCDFs analysis due to the delayed sample arrival of the primary and duplicate samples to the laboratory. The laboratory was instructed to only use contingency volumes for all analyses (i.e., primary sample, duplicate, matrix spike, and matrix spike duplicate).

Eight contingency bottles were utilized for PCB congener analysis due to the delayed sample arrival of the primary and duplicate samples to the laboratory. The laboratory was instructed to only use contingency volumes for all analyses (i.e., primary sample, duplicate, matrix spike, and matrix spike duplicate).

- *Event #1, Attempt #3 Whole Water:* Four contingency bottles were utilized for PCDD/PCDFs analysis due to breakage of one of the four primary bottles for the primary sample. The laboratory was instructed to only use the contingency volumes for the sample analysis.

4.2.4 Grab Metals

As described in Section 2 samples for grab metals, including mercury and methyl mercury analyses, were collected directly from the effluent stream into sample containers and shipped within 24 hours (to meet holding time requirements) to the analytical laboratory for analysis.

Implementation Challenges and Logistics

No significant challenges were encountered during implementation of grab metals sampling. However, with regards to ease of implementation, adequate lead time (approximately 2 to 3 weeks) is required for the

laboratory to decontaminate tubing and sample containers in accordance with the trace metals sampling protocol (USEPA 1996). Additionally, CH and DH sampling procedures needed to be implemented in accordance with SOP No. 5—Metals Sampling via Method 1669 Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels (USEPA 1996) (Tierra 2013). The CH and DH procedures require additional preparation and implementation time in the field. The samples for metals (total and dissolved) were not preserved in the field. To meet the analytical method holding time requirements, metals samples were processed and shipped via overnight carrier within 24 hours of sample collection.

Ability to Generate Target Sample Mass/Volume

The sampling method was able to generate the target sample volume during each sampling event for all target analytical groups.

Contingency Mass/Volume

No contingency volumes were used in the grab metals collection (see Appendix C).

4.3 Summary of Implementability Evaluation

In summary, with the exception of the samples collected during Event #1 Attempt #1 (see Section 4.2.1.1), all three sampling approaches (HSM, LSM, and whole water) were successful in collecting the required field samples for laboratory analyses for all analytical groups during the sampling events/attempts at the Clay Street CSO. Therefore, all samples collected met the evaluation criteria based on implementability and were retained for further evaluation. However, as noted in Section 2, multiple attempts were needed to incrementally (following the analytical hierarchy established in the QAPP) complete the overall sample volume requirements and the LSM particulate samples did not meet the targeted sample mass.

5. Analytical Data Evaluation

This section presents the results of Steps 2, 3 and 4 of the Phase I data evaluation process

5.1 Data Usability

The second step of the evaluation process is an evaluation of the quality of the data generated. As stated above, validated data must contain a minimum of 90% usable data to be further assessed in the evaluation process. Table 5-1 below contains a summary of data that did not meet this criterion and, therefore, was not considered further in the evaluation process. Each is discussed in further detail below.

Table 5-1
Summary of Data Quality Failures

Sample Collection Method and Analytical Group	Event/ Attempt	Primary/ Duplicate Sample	Total Number of Results Reported	Number of Results Affected	% of Results Affected
HSM Particulate– Organochlorine Pesticides	Event #1, Attempt #2	primary	28	4	14
LSM Particulate– SVOCs	Event #1, Attempt #2	primary	50	9	18
HSM Dissolved– SVOCs	Event #1, Attempt #2	primary	50	8	16
HSM Dissolved– SVOCs	Event #1, Attempt #2	duplicate	50	8	16
HSM Particulate– VOCs	Event #1, Attempt #2	primary (fines)	6	4	67
HSM Particulate– VOCs	Event #1, Attempt #2	primary (non-fines)	6	4	67
HSM Particulate– VOCs	Event #1, Attempt #2	duplicate (fines)	6	4	67
HSM Particulate– VOCs	Event #2, Attempt #1	primary (fines)	6	4	67
HSM Particulate– VOCs	Event #2, Attempt #1	primary (non-fines)	6	5	83
HSM Particulate– VOCs	Event #2, Attempt #1	duplicate (fines)	6	4	67

- *HSM Particulate– Organochlorine Pesticides*: Four results in the Event #1, Attempt #2 primary sample were rejected due to labeled analog recovery failure
- *LSM Particulate– SVOCs*: Nine results in the Event #1, Attempt #2 primary sample were rejected due to extremely poor (defined as recovery that is too low to be qualified as an estimate) internal standard response.

- *HSM Dissolved*– SVOCs: Sixteen results in the Event #1, Attempt #2 primary and duplicate samples were rejected due to extremely poor (defined as recovery that is too low to be qualified as an estimate therefore, the data must be rejected) internal standard response.
- *HSM Particulate*– VOCs: Twenty-five results in the Event #1, Attempt #2 and Event #2, Attempt #1 primary (fines), primary (non-fines), and duplicate (fines) samples were rejected due to low internal standard responses.

Note that these data quality issues were related to laboratory performance and are not likely sample collection technique dependent.

All other data for each sampling method and analytical group met the usability requirements set out in the QAPP (Tierra 2013) and were considered further in the evaluation process.

5.2 Decontamination

As discussed in Section 2.4, applicable decontamination procedures were applied throughout the Phase I sample collection program in accordance with SOP No. 6- Decontamination (Tierra 2013). Between sampling events, a full decontamination of the sample collection system was performed in accordance with Section 2.2.2 of SOP No. 6: Decontamination, included in the QAPP (Tierra 2013). Field, rinsate and equipment blanks were collected in accordance with Section 2.4 of SOP No. 6: Decontamination. Positive results identified in the field, rinsate, and equipment blanks collected during Phase I, and associated field blank implications on the data evaluation process are described in Section 5.3.

5.3 Field Blank Results and Affected Sample Results

During the data validation process, positive sample results associated with analytes identified in a field blank were assessed per USEPA Region 2 and other data validation guidance provided in the approved QAPP (Tierra 2013). Positive sample results that fell within the affected concentration range as defined in the validation guidance, were qualified "U", not detected. The number of positive sample results qualified as "U" based on field blank contamination overall are included in Appendix D.

Tierra assessed the potential impact of field blank concentrations on the conclusions of the recommended sample collection method. The details of this assessment are included in Appendix E. The following assumption was made in order to assess the potential impact of field blank concentrations. For the purpose of this evaluation, all detected results as reported by the laboratory prior to validation, are assumed to be those of compounds present in the field sample collected, and not artifacts of background concentrations.

Field blank concentrations were found to have an impact on the recommended sample collection method for the following analytical groups:

- ❑ PCB Congeners- Event #2, Attempt #2 (primary sample)
- ❑ Organochlorine Pesticides- Event #1, Attempt #2(duplicate sample) and Event #2, Attempt #2 (primary sample)
- ❑ SVOCs SIM- Event #1, Attempt #2 (primary sample) and Event #1, Attempt #2 (duplicate sample)
- ❑ Chlorinated Herbicides- Event #2, Attempt #2 (primary sample), Event #2, Attempt #2 (duplicate sample), Event #1, Attempt #3 (primary sample), and Event #1, Attempt #3 (duplicate sample).

5.4 Steps 3 and 4: Frequency of Detections

Data for a given analytical group and sampling method that were not eliminated from the evaluation process during Steps 1 or 2 were assessed in Steps 3 and 4 based on frequency of detections as defined above. A summary of the Steps 3 and 4 evaluations per analytical group are summarized below. In addition, a summary of the overall result of the evaluation process is also provided. As discussed in Section 4, the HSM particulate placed into sample containers by the field team during the first attempt of the first event consisted of only the fines portion of the HSM particulate material. Because this sample was not homogenized with the non-fines portion of the particulate, as was the case during all subsequent sampling attempts and events, data from this first sampling attempt was not considered useable for purposes of the Phase I data evaluation.

5.4.1 Polychlorinated Dibenzop-dioxins/Polychlorinated Dibenzofurans

All three sample collection and processing methods (LSM, HSM, and whole water) were evaluated for the PCDD/PCDFs analytical group. Samples (primary sample and field duplicate) were collected for PCDD/PCDF analysis during Event #1, Attempt #3 and Event #2, Attempt #2. A summary of the findings of the evaluation Steps 3 and 4 for PCDD/PCDF data are provided below. Detailed evaluation sheets (Worksheet #11) can be found in Appendix F.

- ❑ Based on Event #1, Attempt #3 (duplicate samples only), LSM and HSM sample collection methods had greater than 10% more positive results for COPC/COPECs than the whole water sample collection method. Neither LSM nor HSM sample collection methods had greater than 10% more positive results for PCDDs/PCDFs overall. This was not observed in the results for the primary samples; no sample collection method resulted in greater than 10% more positive results for COPC/COPECs or PCDDs/PCDFs overall.

- Based on Event #2, Attempt #2 (primary and duplicate samples), the HSM sample collection method had greater than 10% more positive results for COPC/COPECs than the LSM and whole water sample collection methods.

Overall, the recommended sample collection method(s), if any, based on the results of the Phase I evaluation criteria (Steps 1 to 4) for PCDDs/PCDFs is summarized in Table 52 below.

Table 5-2
Recommended Sample Collection Method- PCDDs/PCDFs

	Event #1, Attempt #3	Event #2, Attempt #2
Primary Sample	Inconclusive	HSM
Duplicate Sample	LSM/HSM	HSM

5.4.2 Polychlorinated Biphenyl Congeners

All three sample collection and processing methods (SM, HSM, and whole water) were evaluated for the PCB congeners analytical group. Samples were collected for PCB congener analysis during Event #1, Attempt #3 and Event #2, Attempt #2. A summary of the findings of evaluation Steps 3 and 4 for PCB congener data are provided below. The detailed evaluation sheets (Worksheet #11) can be found in Appendix G.

- Based on Event #1, Attempt #3 (duplicate samples), the HSM sample collection method had greater than 10% more positive results for COPC/COPECs than the LSM and whole water sample collection methods. The results for the primary sample showed both HSM and LSM sample collection methods had greater than 10% more positive results for COPC/COPECs than the whole water sample collection method; however, the HSM sample collection method also had greater than 10% more positive results for PCB congeners overall.
- Based on Event #2, Attempt #2 (primary samples), the HSM sample collection method had greater than 10% more positive results for COPC/COPECs than the LSM and whole water sample collection methods. The results for the duplicate samples showed both HSM and LSM sample collection methods had greater than 10% more positive results for COPC/COPECs than the whole water sample collection method; however, the HSM sample collection method also had greater than 10% more positive results for PCB congeners overall.

Overall, the recommended sample collection method(s), if any, based on the results of the Phase I evaluation criteria (Steps 1 to 4) for PCB congeners is summarized in Table 53 below.

Table 5-3
Recommended Sample Collection Method– PCB Congeners

	Event #1, Attempt #3	Event #2, Attempt #2
Primary Sample	HSM	HSM
Duplicate Sample	HSM	HSM

5.4.3 Aroclor Polychlorinated Biphenyls

All three sample collection and processing methods (LSM, HSM, and whole water) were evaluated for the Aroclor PCBs analytical group. Samples were collected for Aroclor PCB analysis during Event #1, Attempt #2 and Event #2, Attempt #2. A summary of the findings of evaluation Steps 3 and 4 for Aroclor PCB data are provided below. The detailed evaluation sheets (Worksheet #11) can be found in Appendix H.

- Based on Event #1, Attempt #2 (primary and duplicate samples) the HSM sample collection methods had greater than 10% more positive results for COPC/COPECs than the LSM and whole water sample collection methods.
- Based on Event #2, Attempt #2 (duplicate samples), the HSM sample collection method had greater than 10% more positive results for COPC/COPECs than the LSM and whole water sample collection methods. This was not observed in the results for the primary samples; no sample collection method resulted in greater than 10% more positive results for COPC/COPECs or Aroclor PCBs overall.

Overall, the recommended sample collection method(s), if any, based on the results of the Phase I evaluation criteria (Steps 1 to 4) for Aroclor PCBs is summarized in Table 54 below.

Table 5-4
Recommended Sample Collection Method– Aroclor PCBs

	Event #1, Attempt #2	Event #2, Attempt #2
Primary Sample	HSM	Inconclusive
Duplicate Sample	HSM	HSM

5.4.4 Organochlorine Pesticides

All three sample collection and processing methods (LSM, HSM, and whole water) were evaluated for the organochlorine pesticide analytical group. Samples were collected for organochlorine pesticides analysis during Event #1, Attempt #2 and Event #2, Attempt #2. A summary of the findings of evaluation Steps 3 and 4 for organochlorine pesticide data is provided below. The detailed evaluation sheets (Worksheet #11) can be found in Appendix I.

- Based on Event #1, Attempt #2 (duplicate samples), the HSM sample collection method had greater than 10% more positive results for COPC/COPECs than the LSM and whole water sample collection methods. This was not observed in the results for the primary samples; no sample collection method resulted in greater than 10% more positive results for COPC/COPECs or organochlorine pesticides overall (note the HSM sample collection method for the primary sample was not considered, as the HSM particulate sample was rejected due to data usability issues).
- Based on Event #2, Attempt #2 (primary samples), the HSM sample collection method had greater than 10% more positive results for COPC/COPECs than the LSM and whole water sample collection methods. This was not observed in the results for the duplicate samples; no sample collection method resulted in greater than 10% more positive results for COPC/COPECs or organochlorine pesticides overall.

Overall, the recommended sample collection method(s), if any, based on the results of the Phase I evaluation criteria (Steps 1 to 4) for organochlorine pesticides is summarized in Table 5-5 below.

Table 5-5
Recommended Sample Collection Method- Organochlorine Pesticides

	Event #1, Attempt #2	Event #2, Attempt #2
Primary Sample	Inconclusive	HSM
Duplicate Sample	HSM	Inconclusive

5.4.5 Semivolatile Organic Compounds

All three sample collection and processing methods (SM, HSM, and whole water) were evaluated for the SVOC analytical group. Samples were collected for SVOC analysis during Event #1, Attempt #2 and Event #2, Attempt #2. A summary of the findings of evaluation Steps 3 and 4 for SVOC data are provided below. Note there are no COPECs that are SVOCs. The detailed evaluation sheets (Worksheet #11) can be found in Appendix J.

- Based on Event #1, Attempt #2 (primary and duplicate samples), no sample collection method resulted in greater than 10% more positive results for SVOCs overall (note that three samples were rejected due to data usability issue).
- Based on Event #2, Attempt #2 (primary samples), the HSM sample collection method had greater than 10% more positive results for SVOCs overall than the LSM and whole water sample collection methods. This was not observed in the results for the duplicate samples; no sample collection method resulted in greater than 10% more positive results for SVOCs overall.

Overall, the recommended sample collection method(s), if any, based on the results of the Phase I evaluation criteria (Steps 1 to 4) for SVOCs is summarized in Table 56 below.

Table 5-6
Recommended Sample Collection Method– SVOCs

	Event #1, Attempt #2	Event #2, Attempt #2
Primary Sample	Inconclusive	HSM
Duplicate Sample	Inconclusive	Inconclusive

5.4.6 Semivolatile Organic Compounds Select Ion Monitoring

All three sample collection and processing methods (SM, HSM, and whole water) were evaluated for the SVOC SIM analytical group. Samples were collected for SVOC SIM analysis during Event #1 Attempt #2 and Event #2, Attempt #2. A summary of the findings of evaluation Steps 3 and 4 for SVOC SIM data are provided below. The detailed evaluation sheets (Worksheet #11) can be found in Appendix K.

- Based on Event #1, Attempt #2 (primary and duplicate samples), the HSM sample collection method had greater than 10% more positive results for COPC/COPECs than the LSM and whole water sample collection methods. HSM sample collection method had greater than 10% more positive results for SVOC SIM overall.
- Based on Event #2, Attempt #2 (primary and duplicate samples), the HSM sample collection method had greater than 10% more positive results for COPC/COPECs than the whole water sample collection method but less than 10% more positive results for COPC/COPECs than the LSM sample collection method. Neither LSM nor HSM sample collection method had greater than 10% more positive results for SVOC SIM overall. These observations resulted in the LSM/HSM sample collection methods ranked as equivalent for the primary sample. This was not observed in the results for the duplicate sample. A sample collection method resulted in greater than 10% more positive results for COPC/COPECs or SVOCs SIM overall.

Overall, the recommended sample collection method(s), if any, based on the results of the Phase I evaluation criteria (Steps 1 to 4) for SVOCs SIM is summarized in Table 57 below.

Table 5-7
Recommended Sample Collection Method– SVOCs SIM

	Event #1, Attempt #2	Event #2, Attempt #2
Primary Sample	HSM	LSM/HSM
Duplicate Sample	HSM	Inconclusive

5.4.7 Chlorinated Herbicides

All three sample collection and processing methods (LSM, HSM, and whole water) were evaluated for the chlorinated herbicides analytical group. Samples were collected for chlorinated herbicide analysis during Event #1, Attempt #2; Event #1, Attempt #3; and Event #2, Attempt #2. Three sets of samples were collected due to a laboratory error identified during the herbicide analysis of the HSM particulate sample from Event #2, Attempt #2. The HSM particulate herbicide results indicated that a laboratory control sample associated with the herbicide data had failed. In an attempt to produce results that would be free of qualification, the laboratory was asked to re-extract and re-analyze the sample. The laboratory reported that the remaining HSM particulate sample had developed a mold growth on the surface of the sample. It was decided that the presence of this mold could pose data quality issues; therefore, it was suggested to the USEPA that additional chlorinated herbicide samples be collected during the next sampling event (Event #1 Attempt #3). This was approved by the USEPA in an email correspondence on February 20, 2014 (USEPA 2014). Data from all three sampling events/attempts, including herbicide results from Event #2 Attempt #2 affected by the failed laboratory control sample, have been used in this evaluation. A summary of the findings of evaluation Steps 3 and 4 for chlorinated herbicides data are provided below. Note there are no COPECs that are chlorinated herbicides. The detailed evaluation sheets (Worksheet #11) can be found in Appendix L.

It should be noted that many of the positive chlorinated herbicide results were qualified as tentatively identified at an estimated concentration (NJ). This is a reflection of a larger than acceptable level of uncertainty as to both the qualitative identification of the analyte and the numerical value reported. Across all sample types collected during the three sampling events/attempts, 29 positive chlorinated herbicide results were reported. Of those 29 positive results, 16 were assigned an "NJ" flag during validation. A significant component of the data evaluation process is a comparison of the number of positive results reported between sample collection methods (Steps 3 and 4). Therefore, the conclusions of the data evaluation process, and thereby the selection of a recommended sample collection method, may have been impacted by the larger than acceptable uncertainty in qualitative analyte identification noted during herbicide data validation.

- Based on Event #1, Attempt #2 (primary samples), the LSM sample collection method had greater than 10% more positive results for chlorinated herbicides overall than the HSM and whole water sample collection methods. For the duplicate samples, the LSM and HSM sample collection methods resulted in greater than 10% more positive results for chlorinated herbicides overall than the whole water sample collection method.
- Based on Event #1, Attempt #3 (primary samples), the HSM and whole water sample collection methods resulted in greater than 10% more positive results for chlorinated herbicides overall than the LSM sample collection method. For the duplicate samples, the LSM and whole water sample collection

methods resulted in greater than 10% more positive results for chlorinated herbicides overall than the HSM sample collection method.

- Based on Event #2, Attempt #2 (primary samples), the HSM sample collection method resulted in greater than 10% more positive results for chlorinated herbicides overall than the LSM and whole water sample collection methods. For the duplicate samples, the LSM sample collection method resulted in greater than 10% more positive results for chlorinated herbicides overall than the HSM and whole water sample collection methods.

Overall, the recommended sample collection method(s), if any, based on the results of the Phase I evaluation criteria (Steps 1 to 4) for chlorinated herbicides is summarized in Table 5-8 below.

Table 5-8
Recommended Sample Collection Method– Chlorinated Herbicides

	Event #1, Attempt #2	Event #1, Attempt #3	Event #2, Attempt #2
Primary Sample	LSM	HSM/whole water	HSM
Duplicate Sample	LSM/HSM	LSM/whole water	LSM

5.4.8 Cyanide

As per the QAPP (Tierra 2013), only HSM and whole water sample collection methods were evaluated for the cyanide analytical group since only whole water sample collection (and not LSM sample collection) were included in the CSO/SWO S&AP (USEPA 2008).

Samples were collected for cyanide analysis during Event #1, Attempt #2 and Event #2, Attempt #2. A summary of the findings of evaluation Steps 3 and 4 for cyanide data are provided below. Note cyanide is not a COPEC. The detailed evaluation sheets (Worksheet #11) can be found in Appendix M.

- Based on Event #1, Attempt #2 and Event #2, Attempt #2 (primary and duplicate samples), cyanide data exhibited positive results for the analyte in the samples collected using HSM and whole water sample collection methods. Because cyanide is a single-component analytical group with 100% detections for both methods, one sample collection method did not produce greater than 10% more positive results (detections) than all other methods/another method. Therefore, the recommended sample collection method(s) based on the Phase I evaluation criteria is inconclusive.

5.4.9 Volatile Organic Compounds

As per the QAPP (Tierra 2013), only whole water and HSM sample collection and processing methods were evaluated for the VOC analytical group since only whole water sample collection (and not LSM sample

collection) were included in the CSO/SWO S&AP (USEPA 2008). Samples were collected for VOC analysis during Event #1, Attempt #2 and Event #2, Attempt #1. However, samples collected using the HSM sample collection method were rejected due to data usability issues. Therefore, only data for samples collected via the whole water samples collection method were considered usable. The detailed evaluation sheets (Worksheet #11) can be found in Appendix N.

The whole water sample collection method was not selected as the recommended method for VOCs. A limited dataset was available to complete the data comparison between sampling approaches, and only data for samples collected via the whole water method were considered usable. Additional investigation is recommended during Phase II to evaluate sampling approaches for VOCs.

5.4.10 Total Extractable Petroleum Hydrocarbons

As per the QAPP (Tierra 2013), only whole water and HSM sample collection and processing methods were evaluated for the TEPH analytical group since only whole water sample collection (and not LSM sample collection) were included in the CSO/SWO S&AP (USEPA 2008). Samples were collected for TEPH analysis during Event #1, Attempt #2 and Event #2, Attempt #2. A summary of the findings of evaluation Steps 3 and 4 for TEPH data are provided below. Note TEPH is not a COPEC. The detailed evaluation sheets (Worksheet #11) can be found in Appendix O.

- Based on Event #1, Attempt #2 and Event #2, Attempt #2 (primary and duplicate samples), TEPH data exhibited positive results for the analyte in the samples collected using both the HSM and whole water sample collection methods. Because TEPH is a single-component analytical group with 100% detections for both methods, one sample collection method did not produce greater than 10% more positive results (detections) than all other methods ~~another method~~. Therefore, the recommended sample collection method(s) based on the Phase I evaluation criteria is inconclusive.

5.5 Impacts of Achieved Analytical Sensitivity

Sensitivity is related to the ability to compare analytical results with project quantitation limits (PQLs). Analytical detection limits should be at or below the PQLs to allow effective comparisons. All sample analytical results reported during Phase I of the CSO/SWO investigation were evaluated to determine if adequate sensitivity was achieved. The results for each analyte were cross-checked against the PQLs presented in Worksheet #15 of the QAPP (Tierra 2013). The results of this detailed evaluation are presented in the CSO/SWO Investigation Phase I Data Quality Usability Assessment Report (DQUAR; Tierra 2016). The DQUAR (Tierra 2016) is included as Appendix P.

The observation that data obtained for a particular sample type/collection method failed to meet established PQLs for specific analytical groups may have impacted the number of positive results

identified in those samples, thereby potentially impacting the data evaluation process. Tierra performed an evaluation of instances where PQL exceedances were identified to assess any potential impact on the data evaluation process and sample collection method selection. The results of this additional evaluation is also included in the DQUAR (Tierra 2016).

The following table summarizes the conclusions following assessment of the potential impact of PQL exceedances for each sample collection method during the data evaluation and selection process.

Table 5-9
Impact of PQL Exceedances

Analytical Group	PQL Exceedances May Have Impacted the Sample Collection Evaluation Process				
	Yes/No				
	Whole Water	LSM Dissolved	LSM Particulate	HSM Dissolved	HSM Particulate
PCDDs/PCDFs	No	NA	NA	NA	Yes
PCB Congeners	Yes	Yes	Yes	Yes	No
Organochlorine Pesticides	No	No	Yes	No	No
SVOCs SIM	No	Yes	Yes	NA	Yes
SVOCs	Yes	No	Yes	Yes	Yes
Aroclor PCBs	NA	NA	Yes	NA	No
Chlorinated Herbicides	NA	NA	Yes	Yes	NA
VOCs	NA	NA	NA	NA	No

Notes:

NA= not applicable since non-detected results were not reported when or if PQL exceedances were noted for an analytical group.

5.6 Additional Data Evaluation

A side-by-side comparison of the HSM and LSM particulate and dissolved phase concentrations and whole water was completed outside the scope of the data evaluation criteria as defined in the QAPP (Tierra 2013). Additionally based on comments received from the USEPA dated October 6, 2015 on this Phase I Report (Revision 0), and based on the results obtained for the Phase I sampling program, additional data evaluation was completed for select analytical groups to calculate summary statistics, compare results/concentrations, and evaluate trends to assist with development of the Phase I sampling program. Additional data evaluation was completed for the following analytical groups:

- ☐ PCDD/PCDFs
- ☐ PCB congeners

- ☐ Organochlorine pesticides
- ☐ SVOCs
- ☐ SVOCs SIM
- ☐ Aroclor PCBs
- ☐ Chlorinated herbicides
- ☐ VOCs
- ☐ Cyanide
- ☐ TEPH

Findings and results of the additional data evaluation is included in Attachment 1 - Phase I Report
Addendum – Additional Data Evaluation

6. Conclusion/Recommendation

Based on the Phase I evaluation process, the recommended sample collection methods per analytical group are identified below in Table 6-1. The HSM sample collection method is the preferred approach for certain hydrophobic contaminants such as PCDDs/PCDFs, PCB congeners, Aroclor PCBs, and organochlorine pesticides. For PCB congeners, HSM was the recommended sample collection method for each sample collected (primary and duplicate) based on the Phase I evaluation process. For PCDDs/PCDFs, Aroclor PCBs, and organochlorine pesticides, HSM was the recommended sample collection method for half or more of the samples collected (primary and duplicate) based on the Phase I evaluation process. A preferred sample collection method for the remaining analytical groups was not definitive.

Table 6-1
Phase I Sample Collection Method Recommendations

Sample Collection Technique	PCDD/PCDF	PCB Congeners	Aroclor PCBs	Organochlorine Pesticides	SVOCs SIM	SVOC	Chlorinated Herbicides	Cyanide	VOC	TEPH
LSM						O	O	O	O	O
HSM	☐	☐	☐	☐	☐					
Whole Water										

Notes:

☐ = selected sampling method

O = recommended sample collection method inconclusive

Based on the results of the Phase I evaluation discussed in this Phase I Report, it is recommended that a hybrid sample collection program be implemented for Phase II. Such a hybrid approach would focus on using the most appropriate sampling technique for each applicable parameter group. It is also recommended that Phase II be implemented in additional phases to continue to collect data and make adjustments (if needed) to meet program objectives. Given the number of additional sampling locations remaining to be sampled (eight CSOs, 10 SWOs, and one POTW sample quarterly basis for 1 year) during Phase II, an iterative evaluation of the Phase II data will allow flexibility in making adjustments to the program and help avoid collection of a large amount of data that do not meet program objectives.

Tierra recommends a meeting with the USEPA to review the results of the Phase I evaluation and develop the approach and scope for the Phase II CSO/SWO investigation program that considers factors including sampling technique, implementability, data needs, locations, and schedule.

7. References

Great Lakes Environmental Center 2008. New York-New Jersey Harbor Estuary Program Contaminant Assessment and Reduction Program New Jersey Toxics Reduction Work Plan Study-G Project Report, February 2008

Malcolm Pimie, Inc. 2008. Rain Event Program Narrative, Lower Passaic River Restoration Project (version 11/05/2008) Source: www.ourPassaic.org

The Louis Berger Group (in conjunction with Battelle HDR/HydroQual) 2014. Lower Eight Miles of the Lower Passaic River. Focused Feasibility Report. For U. S. Environmental Protection Agency, Region 2 and U.S. Army Corps of Engineers, Kansas City District.

Tierra. 2002. Remedial Investigation– Combined Sewer Overflow Investigation, Volume 1, Work Plan/Field Sampling Plan. May.

Tierra. 2013. Combined Sewer Overflow/Stormwater Outfall Investigation Quality Assurance Project Plan. Lower Passaic River Study Area. Revision 3. September 2013.

Tierra 2016. Combined Sewer Overflow/Stormwater Outfall Investigation Phase I Data Quality Usability Assessment Report, Revision 1. March 2016.

USEPA. 1996. Method 1669, Sampling Ambient Water for Trace Metals at EPA Water Criterion Levels, U.S. Environmental Protection Agency, Office of Water Engineering and Analysis Division (4303), July 1996

USEPA. 2008. Combined Sewer Overflow/Stormwater Overflow Sampling and Analytical Plan, Revision No. 2.0. August.

USEPA. 2014. Email Correspondence approving additional chlorinated herbicide samples. February 20.

Figures

Appendix A

Event #1, Attempt # 1 Results– PCDDs/PCDFs

Appendix B

Event #1, Attempt # 1 Results– PCB Congeners

Appendix C

Contingency Samples Used During CSO Phase I Sampling Events

Appendix D

CSO/SWO Phase I Field Blank Contamination Results

Appendix E

Field Blank Results Assessment

Appendix F

Detailed Evaluation Sheets (Worksheet #11)– PCDDs/PCDFs

Appendix G

Detailed Evaluation Sheets (Worksheet #11)– PCB Congeners

Appendix H

Detailed Evaluation Sheets (Worksheet #11)– Aroclor PCBs

Appendix I

Detailed Evaluation Sheets (Worksheet #11)– Organochlorine Pesticides

Appendix J

Detailed Evaluation Sheets (Worksheet #11)– SVOCs

Appendix K

Detailed Evaluation Sheets (Worksheet #11)– SVOCs SIM

Appendix L

Detailed Evaluation Sheets (Worksheet #11)– Chlorinated Herbicides

Appendix M

Detailed Evaluation Sheets (Worksheet #11)– Cyanide

Appendix N

Detailed Evaluation Sheets (Worksheet #11)– VOCs

Appendix O

Detailed Evaluation Sheets (Worksheet #11)– TEPH

Appendix P

CSO/SWO Phase I Data Quality Usability Assessment Report

Attachment 1

Phase I Report Addendum– Additional Data Evaluation